19-3404; Rev 1; 10/06

EVALUATION KIT AVAILABLE

# LF-to-2.5GHz Dual Logarithmic Detector/ Controller for Power, Gain, and VSWR Measurements



## General Description

The MAX2016 dual logarithmic detector/controller is a fully integrated system designed for measuring and comparing power, gain/loss, and voltage standing-wave ratio (VSWR) of two incoming RF signals. An internal broadband impedance match on the two differential RF input ports allows for the simultaneous monitoring of signals ranging from low frequency to 2.5GHz.

The MAX2016 uses a pair of logarithmic amplifiers to detect and compare the power levels of two RF input signals. The device internally subtracts one power level from the other to provide a DC output voltage that is proportional to the power difference (gain). The MAX2016 can also measure the return loss/VSWR of an RF signal by monitoring the incident and reflected power levels associated with any given load. A window detector is easily implemented by using the on-chip comparators, OR gate, and 2V reference. This combination of circuitry provides an automatic indication of when the measured gain is outside a programmable range. Alarm monitoring can thus be implemented for detecting high-VSWR states (such as open or shorted loads).

The MAX2016 operates from a single +2.7V to +5.25V* power supply and is specified over the extended -40°C to +85°C temperature range. The MAX2016 is available in a space-saving, 5mm x 5mm, 28-pin thin QFN.

## Applications

Return Loss/VSWR Measurements

Dual-Channel RF Power Measurements

Dual-Channel Precision AGC/RF Power Control

Log Ratio Function for RF Signals

Remote System Monitoring and Diagnostics

Cellular Base Station, Microwave Link, Radar, and other Military Applications

RF/IF Power Amplifier (PA) Linearization

***Typical Application Circuit appears at end of data sheet.***

## Features

- ♦ **Complete Gain and VSWR Detector/Controller**
- ♦ **Dual-Channel RF Power Detector/Controller**
- ♦ **Low-Frequency to 2.5GHz Frequency Range**
- ♦ **Exceptional Accuracy Over Temperature**
- ♦ **High 80dB Dynamic Range**
- ♦ **2.7V to 5.25V Supply Voltage Range***
- ♦ **Internal 2V Reference**
- ♦ **Scaling Stable Over Supply and Temperature Variations**
- ♦ **Controller Mode with Error Output**
- ♦ **Available in 5mm x 5mm, 28-Pin Thin QFN Package**

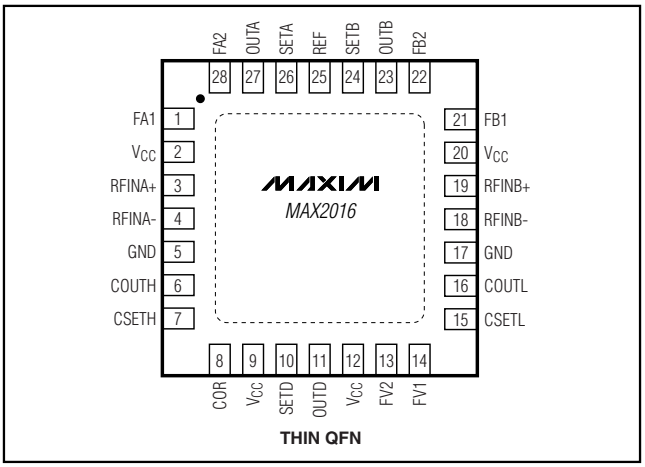
*See *Power-Supply Connection* section.

## Ordering Information

| PART | TEMP RANGE | PIN-PACKAGE | PKG CODE |
|---|---|---|---|
| MAX2016ETI | -40°C to +85°C | 28 Thin QFN-EP*, bulk | T2855-3 |
| MAX2016ETI-T | -40°C to +85°C | 28 Thin QFN-EP*, T/R | T2855-3 |
| MAX2016ETI+D | -40°C to +85°C | 28 Thin QFN-EP*, lead free, bulk | T2855-3 |
| MAX2016ETI+TD | -40°C to +85°C | 28 Thin QFN-EP*, lead free, T/R | T2855-3 |

*EP = Exposed pad.
+Indicates lead-free package.
D = Dry pack.

## Pin Configuration




THIN QFN

# LF-to-2.5GHz Dual Logarithmic Detector/ Controller for Power, Gain, and VSWR Measurements

## ABSOLUTE MAXIMUM RATINGS

$V_{CC}$ to GND .....-0.3V to +5.25V
Input Power Differential (RFIN_+, RFIN_-).....+23dBm
Input Power Single Ended (RFIN_+ or RFIN _-).....+19dBm
All Other Pins to GND.....-0.3V to ($V_{CC}$ + 0.3V)
Continuous Power Dissipation ($T_A$ = +70°C)
28-Pin, 5mm x 5mm Thin QFN (derate 35.7mW/°C above +70°C).....2.8W
Operating Temperature Range .....-40°C to +85°C
Junction Temperature.....+150°C
Storage Temperature Range.....-65°C to +150°C
Lead Temperature (soldering, 10s) .....+300°C

*Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.*

## DC ELECTRICAL CHARACTERISTICS

($V_{CC}$ = +2.7V to +3.6V, $R_1$ = $R_2$ = $R_3$ = 0Ω, $T_A$ = -40°C to +85°C, unless otherwise noted. Typical values are at $V_{CC}$ = +3.3V, CSETL = CSETH = $V_{CC}$, 50Ω RF system, $T_A$ = +25°C, unless otherwise noted.) (Note 1)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| **POWER SUPPLY** | | | | | | |
| Supply Voltage | $V_S$ | $R_6$ = 0Ω | 2.7 | 3.3 | 3.6 | V |
| | $V_S$ | $R_6$ = 37.4Ω | 4.75 | 5 | 5.25 | |
| Total Supply Current | $I_{CC}$ | | | 43 | 55 | mA |
| Supply Current | | Measured in each pin 2 and pin 20 | | 16 | | mA |
| | | Measured in pin 9 | | 2 | | |
| | | Measured in pin 12 | | 9 | | |
| **INPUT INTERFACE** | | | | | | |
| Input Impedance | | Differential impedance at RFINA and RFINB | | 50 | | Ω |
| Input Resistance | R | Resistance at SETD | | 20 | | kΩ |
| | | Resistance at SETA and SETB | | 40 | | |
| **DETECTOR OUTPUT** | | | | | | |
| Source Current | | Measured at OUTA, OUTB, and OUTD | | 4 | | mA |
| Sink Current | | Measured at OUTA, OUTB, and OUTD | | 0.45 | | mA |
| Minimum Output Voltage | | Measured at OUTA, OUTB, and OUTD | | 0.5 | | V |
| Maximum Output Voltage | | Measured at OUTA, OUTB, and OUTD | | 1.8 | | V |
| Difference Output VOUTD | | $P_{RFINA}$ = $P_{RFINB}$ = -30dBm | | 1 | | V |
| OUTD Accuracy | | | | ±12 | | mV |
| **COMPARATORS** | | | | | | |
| Output High Voltage | $V_{OH}$ | $R_{LOAD}$ ≥ 10kΩ | | $V_{CC}$ - 10mV | | V |
| Output Low Voltage | $V_{OL}$ | $R_{LOAD}$ ≥ 10kΩ | | 10 | | mV |
| Input Voltage | | Measured at CSETL and CSETH | | GND to $V_{CC}$ | | V |
| Input Bias Current | | CSETL and CSETH | | 1 | | nA |
| **REFERENCE** | | | | | | |
| Output Voltage on Pin 25 | | $R_{LOAD}$ ≥ 2kΩ | | 2 | | V |
| Load Regulation | | Source 2mA | | -5 | | mV |

## AC ELECTRICAL CHARACTERISTICS—OUTA AND OUTB

(*Typical Application Circuit*, $V_{CC}$ = +2.7V to +3.3V, $R_1 = R_2 = R_3 = 0\Omega$, $T_A$ = -40°C to +85°C, unless otherwise noted. Typical values are at $V_{CC}$ = 3.3V, CSETL = CSETH = $V_{CC}$, $T_A$ = +25°C, unless otherwise noted.) (Note 1)

| PARAMETER | SYMBOL | CONDITIONS | | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| RF Input Frequency Range | $f_{RF}$ | AC-coupled input | | | | 2.5 | GHz |
| Return Loss | $S_{11}$ | 0.1GHz to 3GHz | | | 20 | | dB |
| Large-Signal Response Time | | $P_{RFIN}$ = no signal to 0dBm, ±0.5dB settling accuracy | | | 100 | | ns |
| **RSSI MODE—0.1GHz** | | | | | | | |
| RF Input Power Range | | (Note 2) | | | -70 to +10 | | dBm |
| ±3dB Dynamic Range | | $T_A$ = -20°C to +85°C (Note 3) | | | 80 | | dB |
| Range Center | | | | | -32 | | dBm |
| Temperature Sensitivity | | $P_{RFINA} = P_{RFINB}$ = -32dBm | $T_A$ = +25°C to +85°C | | +0.0083 | | dB/°C |
| | | | $T_A$ = +25°C to -20°C | | -0.0083 | | |
| Slope | | (Note 4) | | | 19 | | mV/dB |
| Typical Slope Variation | | $T_A$ = -20°C to +85°C | | | -4 | | µV/°C |
| Intercept | | (Note 5) | | | -100 | | dBm |
| Typical Intercept Variation | | $T_A$ = -20°C to +85°C | | | 0.03 | | dBm/°C |
| **RSSI MODE—0.9GHz** | | | | | | | |
| RF Input Power Range | | (Note 2) | | | -70 to +10 | | dBm |
| ±3dB Dynamic Range | | $T_A$ = -20°C to +85°C (Note 3) | | | 80 | | dB |
| Range Center | | | | | -30 | | dBm |
| Temperature Sensitivity | | $P_{RFINA} = P_{RFINB}$ = -30dBm | $T_A$ = +25°C to +85°C | | +0.0083 | | dB/°C |
| | | | $T_A$ = +25°C to -20°C | | -0.0083 | | |
| Slope | | (Note 4) | | | 18.1 | | mV/dB |
| Typical Slope Variation | | $T_A$ = -20°C to +85°C | | | -4 | | µV/°C |
| Intercept | | (Note 5) | | | -97 | | dBm |
| Typical Intercept Variation | | $T_A$ = -20°C to +85°C | | | 0.02 | | dBm/°C |
| **RSSI MODE—1.9GHz** | | | | | | | |
| RF Input Power Range | | (Note 2) | | | -55 to +12 | | dBm |
| ±3dB Dynamic Range | | $T_A$ = -20°C to +85°C (Note 3) | | | 67 | | dB |
| Range Center | | | | | -27 | | dBm |
| Temperature Sensitivity | | $P_{RFINA} = P_{RFINB}$ = -27dBm | $T_A$ = +25°C to +85°C | | +0.0125 | | dB/°C |
| | | | $T_A$ = +25°C to -20°C | | -0.0125 | | |
| Slope | | (Note 4) | | | 18 | | mV/dB |
| Typical Slope Variation | | $T_A$ = -20°C to +85°C | | | -4.8 | | µV/°C |
| Intercept | | (Note 5) | | | -88 | | dBm |
| Typical Intercept Variation | | $T_A$ = -20°C to +85°C | | | 0.03 | | dBm/°C |

# LF-to-2.5GHz Dual Logarithmic Detector/ Controller for Power, Gain, and VSWR Measurements

## AC ELECTRICAL CHARACTERISTICS—OUTA AND OUTB (continued)

(*Typical Application Circuit*, $V_{CC}$ = +2.7V to +3.3V, $R_1 = R_2 = R_3 = 0\Omega$, $T_A$ = -40°C to +85°C, unless otherwise noted. Typical values are at $V_{CC}$ = 3.3V, CSETL = CSETH = $V_{CC}$, $T_A$ = +25°C, unless otherwise noted.) (Note 1)

| PARAMETER | SYMBOL | CONDITIONS | | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| **RSSI MODE—2.17GHz** | | | | | | | |
| RF Input Power Range | | (Note 2) | | | -52 to +12 | | dBm |
| ±3dB Dynamic Range | | $T_A$ = -20°C to +85°C (Note 3) | | | 64 | | dB |
| Range Center | | | | | -25 | | dBm |
| Temperature Sensitivity | | $P_{RFINA} = P_{RFINB}$ = -25dBm | $T_A$ = +25°C to +85°C | | +0.0135 | | dB/°C |
| | | | $T_A$ = +25°C to -20°C | | -0.0135 | | |
| Slope | | (Note 4) | | | 17.8 | | mV/dB |
| Typical Slope Variation | | $T_A$ = -20°C to +85°C | | | -8 | | µV/°C |
| Intercept | | (Note 5) | | | -81 | | dBm |
| Typical Intercept Variation | | $T_A$ = -20°C to +85°C | | | 0.03 | | dBm/°C |
| **RSSI MODE—2.5GHz** | | | | | | | |
| RF Input Power Range | | (Note 2) | | | -45 to +7 | | dBm |
| ±3dB Dynamic Range | | $T_A$ = -20°C to +85°C (Note 3) | | | 52 | | dB |
| Range Center | | | | | -23 | | dBm |
| Temperature Sensitivity | | $P_{RFINA} = P_{RFINB}$ = -23dBm | $T_A$ = +25°C to +85°C | | +0.0167 | | dB/°C |
| | | | $T_A$ = +25°C to -20°C | | -0.0167 | | |
| Slope | | (Note 4) | | | 17.8 | | mV/dB |
| Typical Slope Variation | | $T_A$ = -20°C to +85°C | | | -8 | | µV/°C |
| Intercept | | (Note 5) | | | -80 | | dBm |
| Typical Intercept Variation | | $T_A$ = -20°C to +85°C | | | 0.03 | | dBm/°C |

## AC ELECTRICAL CHARACTERISTICS—OUTD

(*Typical Application Circuit*, $V_{CC}$ = +2.7V to +3.3V, $R_1 = R_2 = R_3 = 0\Omega$, $T_A$ = -40°C to +85°C, unless otherwise noted. Typical values are at $V_{CC}$ = 3.3V, CSETL = CSETH = $V_{CC}$, $T_A$ = +25°C, unless otherwise noted.) (Note 1)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| OUTD Center Point | | $P_{RFINA} = P_{RFINB}$ | | 1 | | V |
| Small-Signal Envelope Bandwidth | | No external capacitor on pins FV1 and FV2 | | 22 | | MHz |
| Small-Signal Settling Time | | Any 8dB change on the inputs, no external capacitor on FV1 and FV2, settling accuracy is ±0.5dB | | 150 | | ns |
| Large-Signal Settling Time | | Any 30dB change on the inputs, no external capacitor on pins FV1 and FV2, settling accuracy is ±0.5dB | | 300 | | ns |
| Small-Signal Rise and Fall Time | | Any 8dB step, no external capacitor on pins FV1 and FV2 | | 15 | | ns |

## AC ELECTRICAL CHARACTERISTICS—OUTD (continued)

(*Typical Application Circuit*, $V_{CC}$ = +2.7V to +3.3V, $R_1 = R_2 = R_3 = 0\Omega$, $T_A$ = -40°C to +85°C, unless otherwise noted. Typical values are at $V_{CC}$ = 3.3V, CSETL = CSETH = $V_{CC}$, $T_A$ = +25°C, unless otherwise noted.) (Note 1)

| PARAMETER | SYMBOL | CONDITIONS | | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| Large-Signal Rise and Fall Time | | Any 30dB step, no external capacitor on pins FV1 and FV2 | | | 35 | | ns |
| ±1dB Dynamic Range | | 0.1GHz | $P_{RFINB}$ = -32dBm | | 80 | | dB |
| | | 0.9GHz | $P_{RFINB}$ = -30dBm | | 75 | | |
| | | 1.9GHz | $P_{RFINB}$ = -27dBm | | 60 | | |
| | | 2.17GHz | $P_{RFINB}$ = -25dBm | | 55 | | |
| | | 2.5GHz | $P_{RFINB}$ = -23dBm | | 50 | | |
| Slope | | $f_{RF}$ = 0.1GHz to 2.5GHz (A-B) | | | -25 | | mV/dB |
| OUTD Voltage Deviation | | $P_{RFINA} = P_{RFINB}$ = -30dBm, $T_A$ = -20°C to +85°C | | | ±0.25 | | dB |
| ±1dB Dynamic Range over Temperature Relative to Best-Fit Curve at +25°C | | $P_{RFINA}$ is swept ; $T_A$ = -20°C to +85°C | 0.1GHz, $P_{RFINB}$ = -32dBm | | 80 | | dB |
| | | | 0.9GHz, $P_{RFINB}$ = -30dBm | | 70 | | |
| | | | 1.9GHz, $P_{RFINB}$ = -27dBm | | 55 | | |
| | | | 2.17GHz, $P_{RFINB}$ = -25dBm | | 50 | | |
| | | | 2.5GHz, $P_{RFINB}$ = -23dBm | | 45 | | |
| Gain Measurement Balance | | $P_{RFINB} = P_{RFINB}$ = -50dBm to -5dBm, $f_{RF}$ = 1.9GHz | | | 0.2 | | dB |
| Channel Isolation | | 0.9GHz | | | 90 | | dB |
| | | 1.9GHz | | | 65 | | |
| | | 2.5GHz | | | 55 | | |

**Note 1:** The MAX2016 is tested at $T_A$ = +25°C and is guaranteed by design for $T_A$ = -40°C to +85°C.
**Note 2:** Typical minimum and maximum range of the detector at the stated frequency.
**Note 3:** Dynamic range refers to the range over which the error remains within the ±3dB range.
**Note 4:** The slope is the variation of the output voltage per change in input power. It is calculated by fitting a root-mean-square straight line to the data indicated by the RF input power range.
**Note 5:** The intercept is an extrapolated value that corresponds to the output power for which the output voltage is zero. It is calculated by fitting a root-mean-square straight line to the data.

# LF-to-2.5GHz Dual Logarithmic Detector/ Controller for Power, Gain, and VSWR Measurements

## Pin Description

| PIN | NAME | FUNCTION |
|---|---|---|
| 1, 28 | FA1, FA2 | External Capacitor Input. Connecting a capacitor between FA1 and FA2 sets the highpass cutoff frequency corner for detector A (see the *Input Highpass Filter* section). |
| 2, 9, 12, 20 | $V_{CC}$ | Supply Voltage. Bypass with capacitors as specified in the *Typical Application Circuit*. Place capacitors as close to each $V_{CC}$ as possible (see the *Power-Supply Connections* section). |
| 3, 4 | RFINA+, RFINA- | Differential RF Inputs for Detector A. Requires external DC-blocking capacitors. |
| 5, 17 | GND | Ground. Connect to the PCB ground plane. |
| 6 | COUTH | High-Comparator Output |
| 7 | CSETH | Threshold Input on High Comparator |
| 8 | COR | Comparator OR Logic Output. Output of COUTH ORed with COUTL. |
| 10 | SETD | Set-Point Input for Gain Detector |
| 11 | OUTD | DC Output Voltage Representing $P_{RFINA}$ - $P_{RFINB}$. This output provides a DC voltage proportional to the difference of the input RF powers on RFINA and RFINB. |
| 13, 14 | FV2, FV1 | Video-Filter Capacitor Inputs for OUTD |
| 15 | CSETL | Threshold Set Input on Low Comparator |
| 16 | COUTL | Low-Comparator Output |
| 18, 19 | RFINB-, RFINB+ | Differential RF Inputs for Detector B. Requires external DC-blocking capacitors. |
| 21, 22 | FB1, FB2 | External Capacitor Input. Connecting a capacitor between FB1 and FB2 sets the highpass cutoff frequency corner for detector B (see the *Input Highpass Filter* section). |
| 23 | OUTB | Detector B Output. This output provides a voltage proportional to the log of the input power on differential inputs RFINB+ and RFINB- (RFINB). |
| 24 | SETB | Set-Point Input for Detector B |
| 25 | REF | 2V Reference Output |
| 26 | SETA | Set-Point Input for Detector A |
| 27 | OUTA | Detector A Output. This output provides a voltage proportional to the log of the input power on differential inputs RFINA+ and RFINA- (RFINA). |
| EP | GND | Exposed Paddle. EP must connect to the PCB ground plane. |

## Detailed Description

The MAX2016 dual logarithmic amplifier is designed for a multitude of applications including dual-channel RF power measurements, AGC control, gain/loss detection, and VSWR monitoring. This device measures RF signals ranging from low frequency to 2.5GHz, and operates from a single 2.7V to 5.25V (using series resistor, R6) power supply. As with its single-channel counterpart (MAX2015), the MAX2016 provides unparalleled performance with a high 80dB dynamic range at 100MHz and exceptional accuracy over the extended temperature and supply voltage ranges.

The MAX2016 uses a pair of logarithmic amplifiers to detect and compare the power levels of two RF input signals. The device subtracts one power level from the other to provide a DC output voltage that is proportional to the power difference (gain). The MAX2016 can also measure the return loss/VSWR of an RF signal by monitoring the incident and reflected power levels associated with any given load.

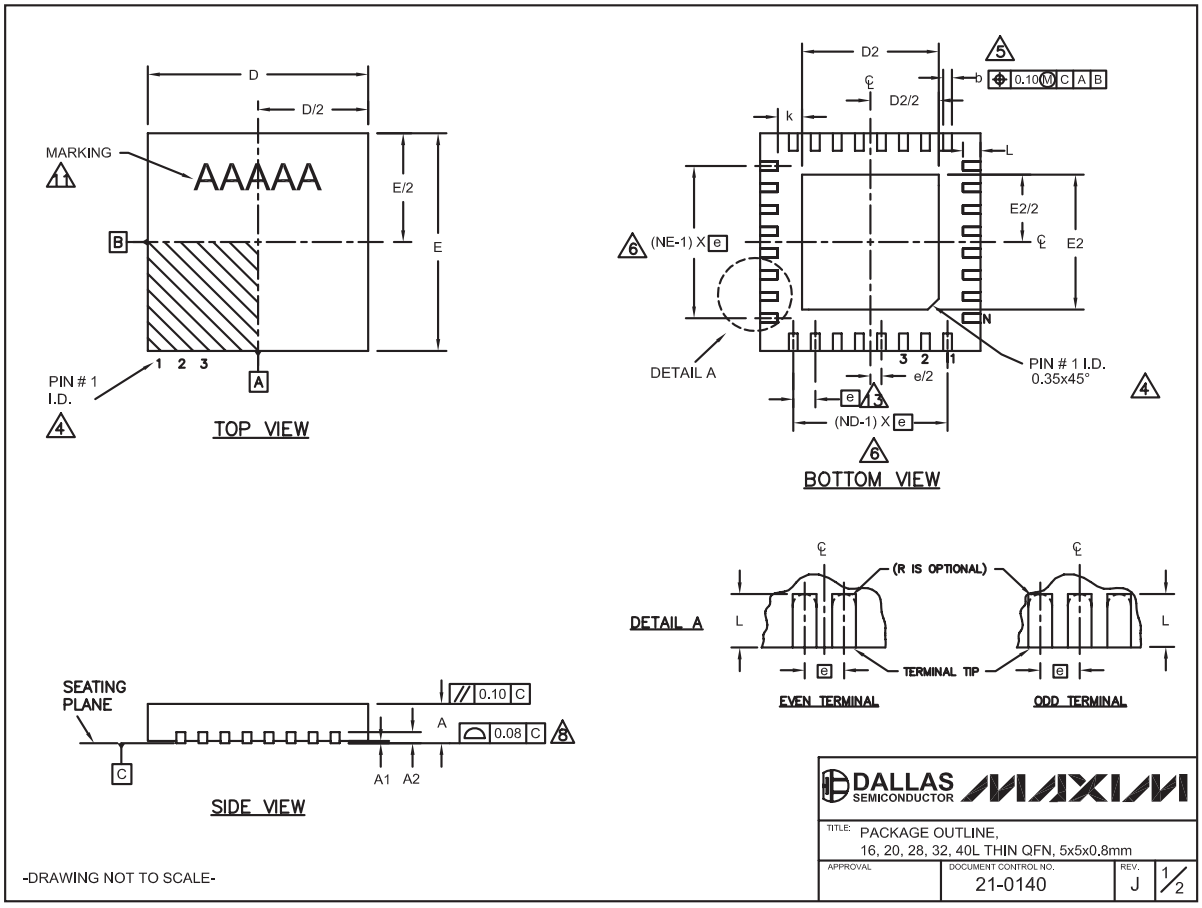
A window detector is easily implemented by using the on-chip comparators, OR gate, and 2V reference. This combination of circuitry provides an automatic indication of when the measured gain is outside a programmable range. Alarm monitoring can thus be implemented for detecting high-VSWR states (such as open or shorted loads).

### RF Inputs (RFINA and RFINB)

The MAX2016 has two differential RF inputs. The input to detector A (RFINA) uses the two input ports RFINA+ and RFINA-, and the input to detector B (RFINB) uses the two input ports RFINB+ and RFINB-.

## Package Information

QFN THIN.EPS



# LF-to-2.5GHz Dual Logarithmic Detector/ Controller for Power, Gain, and VSWR Measurements



## Package Information (continued)

| COMMON DIMENSIONS | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PKG. | 16L 5x5 | | | 20L 5x5 | | | 28L 5x5 | | | 32L 5x5 | | | 40L 5x5 | | |
| SYMBOL | MIN. | NOM. | MAX. | MIN. | NOM. | MAX. | MIN. | NOM. | MAX. | MIN. | NOM. | MAX. | MIN. | NOM. | MAX. |
| A | 0.70 | 0.75 | 0.80 | 0.70 | 0.75 | 0.80 | 0.70 | 0.75 | 0.80 | 0.70 | 0.75 | 0.80 | 0.70 | 0.75 | 0.80 |
| A1 | 0 | 0.02 | 0.05 | 0 | 0.02 | 0.05 | 0 | 0.02 | 0.05 | 0 | 0.02 | 0.05 | 0 | 0.02 | 0.05 |
| A2 | 0.20 REF. | | | 0.20 REF. | | | 0.20 REF. | | | 0.20 REF. | | | 0.20 REF. | | |
| b | 0.25 | 0.30 | 0.35 | 0.25 | 0.30 | 0.35 | 0.20 | 0.25 | 0.30 | 0.20 | 0.25 | 0.30 | 0.15 | 0.20 | 0.25 |
| D | 4.90 | 5.00 | 5.10 | 4.90 | 5.00 | 5.10 | 4.90 | 5.00 | 5.10 | 4.90 | 5.00 | 5.10 | 4.90 | 5.00 | 5.10 |
| E | 4.90 | 5.00 | 5.10 | 4.90 | 5.00 | 5.10 | 4.90 | 5.00 | 5.10 | 4.90 | 5.00 | 5.10 | 4.90 | 5.00 | 5.10 |
| e | 0.80 BSC. | | | 0.65 BSC. | | | 0.50 BSC. | | | 0.50 BSC. | | | 0.40 BSC. | | |
| k | 0.25 | - | - | 0.25 | - | - | 0.25 | - | - | 0.25 | - | - | 0.25 | - | - |
| L | 0.30 | 0.40 | 0.50 | 0.45 | 0.55 | 0.65 | 0.45 | 0.55 | 0.65 | 0.30 | 0.40 | 0.50 | 0.30 | 0.40 | 0.50 |
| N | 16 | | | 20 | | | 28 | | | 32 | | | 40 | | |
| ND | 4 | | | 5 | | | 7 | | | 8 | | | 10 | | |
| NE | 4 | | | 5 | | | 7 | | | 8 | | | 10 | | |
| JEDEC | WHHB | | | WHHC | | | WHHD-1 | | | WHHD-2 | | | ----- | | |

| EXPOSED PAD VARIATIONS | | | | | | |
|---|---|---|---|---|---|---|
| PKG. CODES | D2 | | | E2 | | |
| | MIN. | NOM. | MAX. | MIN. | NOM. | MAX. |
| T1655-2 | 3.00 | 3.10 | 3.20 | 3.00 | 3.10 | 3.20 |
| T1655-3 | 3.00 | 3.10 | 3.20 | 3.00 | 3.10 | 3.20 |
| T1655N-1 | 3.00 | 3.10 | 3.20 | 3.00 | 3.10 | 3.20 |
| T2055-3 | 3.00 | 3.10 | 3.20 | 3.00 | 3.10 | 3.20 |
| T2055-4 | 3.00 | 3.10 | 3.20 | 3.00 | 3.10 | 3.20 |
| T2055-5 | 3.15 | 3.25 | 3.35 | 3.15 | 3.25 | 3.35 |
| T2855-3 | 3.15 | 3.25 | 3.35 | 3.15 | 3.25 | 3.35 |
| T2855-4 | 2.60 | 2.70 | 2.80 | 2.60 | 2.70 | 2.80 |
| T2855-5 | 2.60 | 2.70 | 2.80 | 2.60 | 2.70 | 2.80 |
| T2855-6 | 3.15 | 3.25 | 3.35 | 3.15 | 3.25 | 3.35 |
| T2855-7 | 2.60 | 2.70 | 2.80 | 2.60 | 2.70 | 2.80 |
| T2855-8 | 3.15 | 3.25 | 3.35 | 3.15 | 3.25 | 3.35 |
| T2855N-1 | 3.15 | 3.25 | 3.35 | 3.15 | 3.25 | 3.35 |
| T3255-3 | 3.00 | 3.10 | 3.20 | 3.00 | 3.10 | 3.20 |
| T3255-4 | 3.00 | 3.10 | 3.20 | 3.00 | 3.10 | 3.20 |
| T3255-5 | 3.00 | 3.10 | 3.20 | 3.00 | 3.10 | 3.20 |
| T3255N-1 | 3.00 | 3.10 | 3.20 | 3.00 | 3.10 | 3.20 |
| T4055-1 | 3.40 | 3.50 | 3.60 | 3.40 | 3.50 | 3.60 |
| T4055-2 | 3.40 | 3.50 | 3.60 | 3.40 | 3.50 | 3.60 |

**SEE COMMON DIMENSIONS TABLE

NOTES:

1. DIMENSIONING & TOLERANCING CONFORM TO ASME Y14.5M-1994.
2. ALL DIMENSIONS ARE IN MILLIMETERS. ANGLES ARE IN DEGREES.
3. N IS THE TOTAL NUMBER OF TERMINALS.
4. THE TERMINAL #1 IDENTIFIER AND TERMINAL NUMBERING CONVENTION SHALL CONFORM TO JESD 95-1 SPP-012. DETAILS OF TERMINAL #1 IDENTIFIER ARE OPTIONAL, BUT MUST BE LOCATED WITHIN THE ZONE INDICATED. THE TERMINAL #1 IDENTIFIER MAY BE EITHER A MOLD OR MARKED FEATURE.
5. DIMENSION b APPLIES TO METALLIZED TERMINAL AND IS MEASURED BETWEEN 0.25 mm AND 0.30 mm FROM TERMINAL TIP.
6. ND AND NE REFER TO THE NUMBER OF TERMINALS ON EACH D AND E SIDE RESPECTIVELY.
7. DEPOPULATION IS POSSIBLE IN A SYMMETRICAL FASHION.
8. COPLANARITY APPLIES TO THE EXPOSED HEAT SINK SLUG AS WELL AS THE TERMINALS.
9. DRAWING CONFORMS TO JEDEC MO220, EXCEPT EXPOSED PAD DIMENSION FOR T2855-3 AND T2855-6.
10. WARPAGE SHALL NOT EXCEED 0.10 mm.
11. MARKING IS FOR PACKAGE ORIENTATION REFERENCE ONLY.
12. NUMBER OF LEADS SHOWN ARE FOR REFERENCE ONLY.
13. LEAD CENTERLINES TO BE AT TRUE POSITION AS DEFINED BY BASIC DIMENSION "e", ±0.05.

-DRAWING NOT TO SCALE-

DALLAS SEMICONDUCTOR MAXIM

TITLE: PACKAGE OUTLINE, 16, 20, 28, 32, 40L THIN QFN, 5x5x0.8mm

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